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Pulsed Plasma Accelerators of Different Gas Ions for Surface Modification

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ABSTRACT

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Pulsed Plasma Accelerators of Different Gas Ions for Surface Modification

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Pulsed plasma accelerators (PPA) have been applied for solid surface treatments. The main aim of such treatments was to modify surfaces with improvement of their physical properties and, first of all, of their tribological characteristics. The treatment led to melting of a surface layer, introduction of a significant concentration of nitrogen (when operating with nitrogen ions) into liquid surface layer and subsequent fast solidification.

The PPA consists of the coaxial plasma accelerator (with anode diameter 14 cm, cathode diameter 5 cm, and electrodes length 60 cm). The PPA generates plasma streams with ion energy £ 2 keV, plasma density 2×10^{14} cm⁻³, ion current £ 3 kA/cm², energy density of (5-40) J/cm². Plasma stream duration is 3-6 ms. The ions of different gases (N, H, He, Ar, and their mixtures) utilized in these experiments.

The modification of surfaces of different grades of steels is analyzed in this paper. X-ray analysis, cross-sectional metallography, analysis of microhardness, wear tests was applied for investigation of phase structure and tribological properties of the modified layers. Formation of austenites, carbides and nitrides in modified fine-grained surface layer with a depth up to 30 mm were observed as result of a plasma processing. Comparative analysis of a surface layer structure for different kinds of steels was carried out. Essential improvement of wear properties of treated samples was observed even for preliminary thermally quenched steels. Possible mechanisms of steel surfaces modification are discussed in this report also.